Network Design for Faculty of Computing Block N28B

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SECR 1213 Network Communication
Section - 16
Lecturer: Dr. KAIYISAH HANIS BINTI MOHD AZMI

Submitted by Group G
Liu Wanpeng(A23MJ4016)

Zhao Wei (A23MJ4018)

Thamer Alharbi (A23MJ4015)

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1. Abstract

Abstract

This report outlines the design and feasibility analysis for the network infrastructure of a proposed two-story academic building under the Faculty of Computing. The building will house 4 labs (2 general-purpose labs, 1 Cisco Network Lab, and 1 Embedded Lab) and 2 classrooms, each supporting 30 devices, alongside common areas requiring wireless connectivity.

The network design ensures high-speed, reliable connectivity through wired (Cat6 and OM4 fiber) and wireless solutions, utilizing 7 Cisco Catalyst switches and 6 wireless access points. A custom IP addressing scheme with a subnet mask of 255.224.0.0 efficiently supports 8 identified subnets. The total cost of RM 726,450 is well within the allocated budget of RM 1.3M, leaving ample funds for future upgrades.

The proposed design meets the Faculty's needs for cost-efficiency, scalability, and performance, enabling a future-ready, technology-driven learning environment while supporting anticipated growth over the next 4 years.

Keywords: Network Design, Scalability, IP Addressing, High-Speed Connectivity, Budget Efficiency, Academic Building, Cisco Devices, Cat6 Cabling, OM4 Fiber, Wireless Access Points.

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3. Introduction

The Network Floor Plan Design Project focuses on designing and implementing a scalable, efficient, and cost-effective network infrastructure for a newly proposed two-story academic building. This building is part of the Faculty of Computing's initiative to support the growing demand for high-speed, reliable connectivity in modern educational settings. The project encompasses the design of network layouts, the selection of devices, and the deployment of cabling systems to serve 4 specialized labs, 2 classrooms, and associated common areas such as a student lounge.

3.1 Aims

The primary aim of this project is to create a scalable, manageable, and high-performance network that aligns with the future goals of the Faculty of Computing. Specifically, the design aims to:

1. Provide seamless and high-speed connectivity across all designated areas.
2. Ensure the network is **secure**, capable of mitigating modern cyber threats such as denial-of-service (DoS) attacks and data breaches.
3. Optimize resource allocation to meet both current needs and anticipated growth in users and devices.

3.2 Scope

The scope of this project includes:

1. Designing a detailed network floor plan for a two-story building.
2. Installing and configuring network devices, including routers, switches, and access points, to serve 4 labs and 2 classrooms.
3. Deploying cabling infrastructure, including horizontal (Cat6) and vertical (OM4 fiber) cabling, to support all end-user devices and core network components.
4. Assigning IP addresses and subnet masks to ensure efficient routing and address space utilization.
5. Incorporating wireless access points to provide connectivity for mobile and IoT devices across all areas.

3.3 Objectives

6. To ensure cost-efficiency by staying within the allocated budget of RM 1.3M.
7. To design a network that supports 180 end-user devices (workstations) across the labs and classrooms, with additional wireless capacity for mobile devices.
8. To create a future-proof network that can accommodate a 15% growth in users over the next 4 years.
1. To provide high-speed internet access and seamless connectivity to support modern educational practices, including hybrid learning and IoT applications.

3.4 Assumptions

9. The building will house 4 labs (2 general-purpose labs, 1 Cisco Network Lab, and 1 Embedded Lab) and 2 classrooms, each with 30 devices.
10. The allocated budget of RM 1.3M is sufficient to cover all network-related expenditures, including hardware, cabling, and installation costs.
11. Future growth in users will not exceed the planned 15% capacity increase within the next 4

years.

12. All devices, cabling, and installations will meet international standards for performance and reliability, ensuring long-term durability.

This introduction establishes a comprehensive overview of the project, providing clarity on its purpose, goals, and the strategic direction for achieving them. It serves as a foundation for the subsequent detailed planning and implementation phases.

4. Project Background and Client Overview

4.1 Project Context

The Faculty of Computing at Universiti Teknologi Malaysia (UTM) is undergoing significant growth, requiring an advanced network infrastructure to support a newly proposed two-story academic building. This building will include 4 labs, 2 classrooms, and essential support areas such as offices and common spaces. The project is designed to address existing connectivity limitations while preparing for future demands in teaching, research, and administrative activities.

The current network infrastructure faces issues such as limited bandwidth, inadequate wireless coverage, and outdated hardware, making it unsuitable for modern educational practices and high-density user environments. These challenges necessitate a comprehensive solution to provide seamless, secure, and scalable connectivity across all functional areas of the building.

4.2 Client Overview

The Faculty of Computing currently supports 1,800 students (undergraduate and postgraduate), 100 academic staff, and 40 support staff, with an anticipated growth of 15% over the next 4 years. The proposed building will serve as a hub for technology-driven education, emphasizing interactive and hybrid learning models aligned with Fourth Industrial Revolution (4IR) principles.

The building's layout, based on the CAD floor plan, includes:

1. First Floor:

Two general-purpose labs designed for high-density activities.

An integrated service area for hosting core network devices (e.g., switches, routers, and servers).

A central rest area equipped with IoT connectivity and high-speed Wi-Fi.

2. Second Floor:

An Embedded Lab dedicated to IoT and sensor-based research.

A Cisco Networking Lab equipped for advanced networking training.

A classroom designed for interactive and hybrid teaching.

Administrative offices requiring secure and reliable connectivity.

4.3 Challenges and Issues

1. User Demand:
   The building must support 200–300 concurrent users per floor, requiring robust and high-capacity networking solutions.

2. Security Concerns:
   With increased reliance on IoT and cloud-based tools, there is a growing need to secure the network against cyber threats such as data breaches and denial-of-service (DoS) attacks.

3. Infrastructure Limitations:
   Existing infrastructure lacks scalability, making it difficult to accommodate future growth and high-performance demands.

4. Functional Complexity:
   The diverse use cases of labs, classrooms, and offices require dedicated subnets, VLAN segmentation, and advanced device configurations to ensure seamless operation and management.

4.4 Scope of Solution

This project aims to address these challenges by implementing a scalable, secure, and high-performance network infrastructure, including:

1. Structured Cabling: Deployment of Cat6 for horizontal connectivity and fiber optic cables for vertical backbone connections.
2. Advanced Network Devices: Use of Wi-Fi 6 access points, managed switches, and AI-driven firewalls to ensure high-speed, reliable, and secure connectivity.
3. Dedicated Subnets: Isolating functional areas using VLANs to enhance security and manageability.
4. Security Measures: Implementing intrusion detection systems (IDS), role-based access control (RBAC), and encryption for data protection.
5. Future-proofing: Designing the network to accommodate anticipated user growth and emerging technologies.

This comprehensive approach ensures that the Faculty of Computing's new academic building will meet its immediate needs while providing the scalability and security required for long-term growth.

5. A compiled solution of Task 1-5

5.1 Task 1: Project Setup Report

5.1.1 The results from the task 1

1. Suggested Floor Plan

The team has developed a two-story building layout using the CAD software. The floor plan adheres to the functional requirements of the case study, ensuring clarity and scale accuracy. Key features include:

- First Floor:

Two General Purpose Labs: Designed to accommodate 30 devices each, supporting high-density user activity.

Integrated Service Area: Centrally located to host core network devices (routers, switches, and servers).

Interactive Classroom: Equipped with Wi-Fi for mobile and IoT device connectivity.

- Second Floor:

Embedded Lab: Equipped for IoT and sensor-based research.

Cisco Network Lab: Dedicated to networking education and training.

Interactive Classroom: Designed for hybrid teaching and collaborative learning.

The floor plan includes proper placement of network devices, structured cabling routes, and access points for optimal connectivity.

5.1.2. Reflections on Task 1

1. Effectiveness of Team Formation and Initial Steps

At the start of Task 1, Liuwanpeng was required to form a group, thoroughly review the case study, and design a two-story building floor plan based on the specified requirements. Reflecting on this process:

Team Formation:

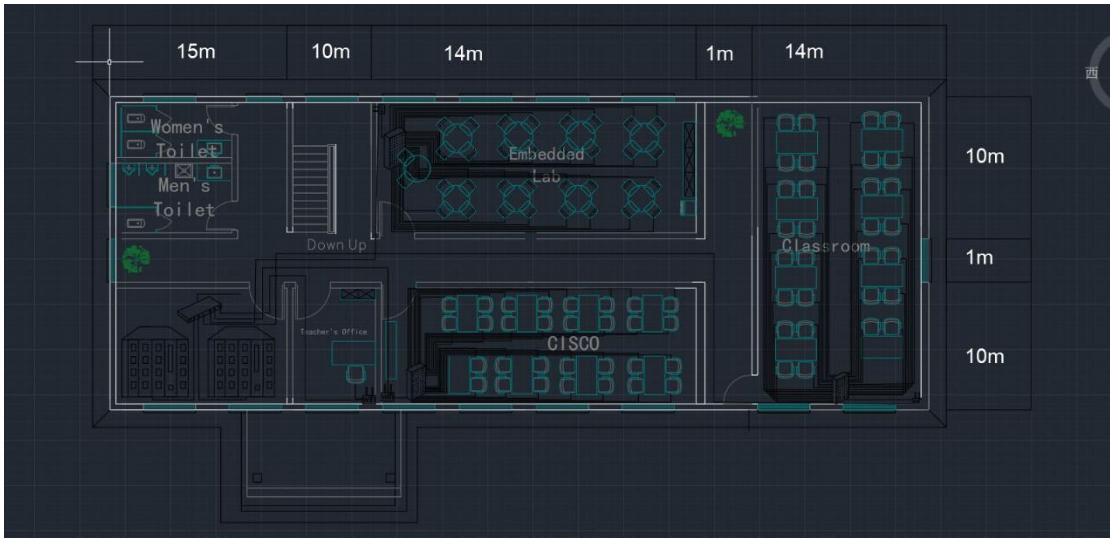
The group was successfully established with two members(Zhao Wei (A23MJ4018); Thamer Alharbi (A23MJ4015)), each assigned roles according to their strengths. Liuwanpeng was responsible for the CAD drawing, while the other members focused on project management, research, and documentation. This balanced allocation of responsibilities ensured the team could work efficiently on multiple aspects of the task simultaneously.

Case Study Review:

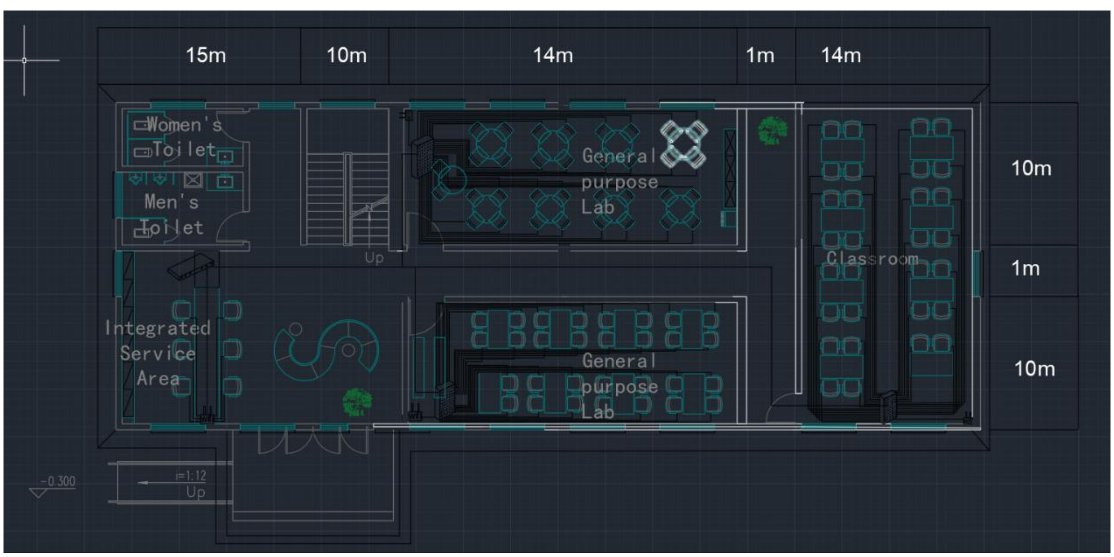
The group reviewed the case study during the initial meetings. However, due to insufficient attention to detail, key requirements, such as the building's structure and laboratory specifications, were overlooked. This lapse in understanding contributed to significant initial errors in the design.

Initial Floor Plan Design:

Liuwanpeng created the initial floor plan but mistakenly designed a three-story building instead of the required two-story structure. Additionally, the laboratory types and dimensions did not align with the case study's requirements. This misstep necessitated a complete redesign, which delayed progress and emphasized the need for greater accuracy in interpreting requirements.



p1.The first floor graphic design drawing



p2.The second floor graphic design drawing

2. Challenges and Adjustments

1. **Oversights in Requirements:**
   The most significant challenge was the initial misunderstanding of key requirements, such as the number and types of laboratories (e.g., General Purpose Labs, Embedded Lab, and Cisco Network Lab). These errors were identified through feedback from **Dr. Kaiyisah Hanis Binti Mohd Azmi**, whose constructive guidance helped the team recognize and correct their mistakes.

2. **Timely Corrections:**
   After identifying the errors, Liuwanpeng immediately initiated a redesign of the floor plan. The final version adhered strictly to the requirements, including the correct number of laboratories, proper unit scales, and accurate proportions. This demonstrated the team's ability to adapt and improve when faced with challenges.

3. Key Lessons Learned

1. **Importance of Detailed Review:**
   Thoroughly understanding the case study is essential to avoid misinterpretations that can lead to significant errors. Future tasks will require more focused attention during the planning phase to ensure compliance with requirements.

2. **Constructive Feedback:**
   The feedback provided by **Dr. Kaiyisah Hanis Binti Mohd Azmi** played a critical role in identifying and resolving errors. This experience underscored the value of seeking guidance when necessary and being open to constructive criticism.

3. **Team Collaboration:**
   The successful reallocation of tasks during the redesign phase showcased the importance of teamwork and effective communication in overcoming setbacks.

4. Projected Marks Based on Rubrics

Using the marking rubric, the group's performance as follows:

Criteria	Score (1-5)	Reasoning
Group Name and Members	5	The group was formed effectively, with clear role assignments based on strengths.
Suggested Floor Plan	4	The final floor plan met the requirements, but initial errors delayed the process.
Meeting Minutes	5	Informative and specific, providing a clear record of decisions and actions taken.
Adherence to Format	4	The report was well-structured, but greater attention to formatting consistency is required.
Overall Score:	**18/20**	Strong overall performance, but initial misunderstandings and delays highlight areas to improve.

List1 Projected Marks Based on Rubrics of task 1

5. Conclusion

Task 1 presented significant challenges, particularly in understanding and applying the case study requirements. However, through effective collaboration, constructive feedback, and adaptive problem-solving, Liuwanpeng and the team successfully completed the task to a high standard. The experience has reinforced the importance of thorough preparation, detailed review, and teamwork in ensuring project success.

Liuwanpeng is deeply grateful to Dr. Kaiyisah Hanis Binti Mohd Azmi for her patience and guidance throughout this process. Despite the initial mistakes, Dr. Kaiyisah Hanis Binti Mohd Azmi provided invaluable feedback, allowing Liuwanpeng to recognize and rectify these errors in a timely manner. Her constructive input played a critical role in ensuring that the final deliverables fully met the requirements of Task 1.

With this comprehensive correction, the final floor plan and all associated deliverables for Task 1 are now completed to a high standard. This process has reinforced the importance of thoroughly understanding project requirements and the value of constructive feedback in achieving success.

5.2 TASK 2: INITIAL DESIGN - PRELIMINARY ANALYSIS

5.2.1 The results from the task 2

1. Some questions and discussions about the project.

1. Does the faculty conduct regular network security checks to ensure the network is protected from external threats? 【1】

- To ensure network security, the construction team should establish a comprehensive network security strategy, including regular vulnerability scans, real-time intrusion detection systems (IDS), and automated security updates. Security checks should be conducted quarterly, with emergency checks initiated upon detecting significant vulnerabilities. This approach helps promptly identify and fix potential security risks, ensuring long-term security and stability of the network.

2. Does the faculty currently have a budget for Internet services, and does it need to consider additional budgets to meet new demands? 【2】

- The budget primarily focuses on capital expenditure (CapEx) for the new building, not operational expenditure (OpEx). Additionally, the construction team should propose budgets covering initial hardware procurement, network equipment installation, infrastructure construction, and future expansion needs. This includes costs for broadband internet connections, redundancy line setups, core network equipment purchases (e.g., switches and routers), and necessary network security equipment.

3. How does the faculty manage its network at present? Is there a dedicated IT team responsible for monitoring and maintenance? 【3】

- According to Dr's professional advice , UTM will handle network operations and maintenance for the new building, with a dedicated team responsible for daily network monitoring and troubleshooting. To ensure efficient network management, it is recommended to implement network management software (e.g., SolarWinds, Nagios), which helps the IT team monitor network performance, traffic flow, and device health in real-time, while generating analytical reports and alerts automatically. This approach can enhance network management efficiency and reduce the risk of unexpected outages.

4. Does the faculty have a data backup process? How is the security of important data ensured? 【4】

- Based on group discussions and online research, The construction team should design and implement a multi-tier data backup strategy, including daily local backups and weekly cloud backups. Important data should also be stored in an encrypted format to prevent unauthorized access. Establishing an automated backup process combined with strict access control policies ensures the integrity and availability of critical data.

5. What are the specific network requirements for each floor's designated purpose and each lab's function (e.g., bandwidth, data traffic, reliability)? 【5】

- Based on group discussions and online research, video conferencing rooms require high bandwidth and low latency connections, while general labs may need stable medium bandwidth. IoT labs may require high data traffic capacity and reliability to support multiple devices simultaneously. The construction team can refer to IEEE standards to define the minimum bandwidth requirements to ensure the needs of all applications are met.

6. What type of network topology is preferred or most suitable (e.g., star, bus, hybrid)? 【6】

- Based on group discussions and online research, to meet the multi-layer network demands of the new building, a hybrid network topology is recommended. Star topology should be used for the core network to facilitate centralized management and efficient data transmission, while bus topology can be adopted within individual labs to enhance flexibility and scalability. This hybrid topology ensures high network performance and provides good fault tolerance and scalability.

7. Are there any specific security requirements for the network, such as firewalls, intrusion detection, or access control? 【7】

- Based on group discussions and online research, it is recommended to introduce next-generation firewalls (NGFW) for deep packet inspection (DPI), along with intrusion detection systems (IDS) or intrusion prevention systems (IPS) for real-time threat detection and response. Additionally, role-based access control (RBAC) should be implemented to ensure that different user groups can only access resources within their permission scope, further enhancing network security.

8. What kind of Internet Service Provider (ISP) options are available, and what are the bandwidth capabilities?

- According to Dr‘s professional advice , the project will be based on UTM specifications, but the construction team must propose specific bandwidth requirements. Based on group discussions, for high-demand areas like video conferencing rooms and IoT labs, it is recommended to provide at least 1 Gbps of bandwidth per floor to support multiple concurrent users for HD meetings and large data transfers. The construction team should also consider multi-path redundancy to improve network availability and fault tolerance.

9. What type of cabling (e.g., Cat5e, Cat6, fiber optic) will be used, and what are the installation standards? 【8】

- Based on group discussions and online research, it is recommended to use fiber optic cables for the backbone network to ensure high-speed data transmission, while Cat6 cables can be used for local area network wiring within floors to meet gigabit network requirements. All wiring should comply with TIA/EIA standards to ensure installation quality and long-term reliability.

10. What type of network devices (e.g., routers, switches, access points) are used by the college now, and what are their specifications? 【9】

- Since this is a new building, based on group discussions and online research, it is suggested to use core routers with advanced routing features, stackable gigabit switches, and Wi-Fi 6-compatible access points to enhance overall network performance and scalability. Network devices should also have redundant power supplies and failover features to improve network stability.

11. Are there any specific compliance or regulatory requirements to be adhered to (e.g., GDPR, HIPAA)? 【10】

- Based on group discussions and online research, considering the importance of data privacy and security, it is recommended to comply with GDPR (General Data Protection Regulation) or similar regulations to protect user data from misuse. If medical or other sensitive data is involved, it is also necessary to consider compliance with industry-specific regulations such as HIPAA (Health Insurance Portability and Accountability Act).

5.13 Document List:

1. National Institute of Standards and Technology (NIST). "Cybersecurity Best Practices for Enterprises." 2021.
2. International Journal of Project Management. "Cost Allocation in IT Projects." 2020.
3. Cisco White Paper. "Network Management Automation: Techniques and Tools." 2019.
4. IEEE Transactions on Cloud Computing. "Data Backup Strategies for Modern Enterprises." 2022.
5. IEEE Network Magazine. "Bandwidth Planning for Smart Buildings." 2023.

6. ACM SIGCOMM. "Hybrid Network Topology in Large-Scale Networks." 2019.
7. SANS Institute Research Report. "Implementing Next-Generation Firewalls." 2020.
8. Optical Fiber Technology. "Fiber Optics in Data Communication Networks." 2022.
9. Network World Journal. "Advanced Network Devices for Enterprise Networks." 2023.
10. Data Privacy Journal. "Data Protection and Compliance in IT Systems." 2022.
11. Special thanks to the Dr. Kaiyisah Hanis Mohd Azmi for her help here.

5.2.2. Reflections on Task 2

1. Effectiveness of Questions and Rationale

During Task 2, Zhao Wei and the group generated a set of 11 questions aimed at identifying the technical and functional requirements for the project. The questions covered a wide range of aspects, such as network security, bandwidth needs, topology preferences, and device specifications. Upon reflection:

- **Helpful Questions:**
  Questions related to specific requirements for each lab (e.g., bandwidth, topology, security protocols) were particularly helpful as they directly impacted the design and implementation strategy. These questions provided clear guidance on allocating resources and selecting devices. For example, the question about the security strategy (5.7) clarified the need for next-generation firewalls and role-based access control (RBAC), which were integral to the design.
- **Less Effective Questions:**
  Some questions, such as ISP options and bandwidth capabilities (5.8), while necessary, overlapped with other queries about high-demand bandwidth needs. These could have been consolidated to make the discussion more focused.
- **Missed Opportunities:**
  While the questions addressed compliance requirements like GDPR, additional focus on sustainability and energy efficiency in the design could have added more depth to the

analysis.

3. Reflection on the Submission Process

Zhao Wei recognizes several areas for improvement in the submission process:

- **Format Adherence:** The final submission lacked explicit alignment with the marking rubric, particularly the section on **"Projected Marks Based on Rubrics."** This oversight reduced the clarity of how the report met the assignment's evaluation criteria.
- **Turnitin Report:** Although the report met academic integrity standards, including a Turnitin report with the submission would have enhanced its credibility and demonstrated compliance with the requirements.
- **Team Coordination:** Some delays in individual contributions, noted in the meeting minutes, indicated that better coordination could have streamlined the process.

4. Key Lessons Learned

1. **Comprehensive Questioning:** Generating questions that are specific and actionable is crucial. Questions directly tied to the project's technical and functional goals (e.g., device specifications, cabling standards) proved to be the most impactful.
2. **Proactive Adjustments:** Revising the floor plan based on findings during the analysis demonstrated adaptability, which is essential for project success.
3. **Attention to Deliverables:** Strict adherence to assignment requirements, such as the inclusion of a Turnitin report and clear rubric alignment, is critical to achieving a high standard of submission.

5. Projected Marks Based on Rubrics

Using the provided rubric, the group's performance as follows:

Criteria	**Score (1-5)**	**Reasoning**
Quality of	5	Questions were specific, relevant, and covered all major areas of

Questions		the project requirements.
Answers and Research	5	Detailed and well-researched responses demonstrated thorough understanding and feasibility.
Feasibility Analysis	5	Comprehensive, addressing technical, financial, and compliance aspects effectively.
Meeting Minutes	4	Informative and specific, though some contributions could have been more timely.
Adherence to Format	3	The submission lacked alignment with rubric details and the Turnitin report.
Overall Score:	**22/25**	Strong technical content and research but room for improvement in submission formatting.

List2 Projected Marks Based on Rubrics of task 2

6. Conclusion

Task 2 reinforced the importance of structured analysis, proactive revisions, and clear alignment with deliverable requirements. Zhao Wei recognizes the need to improve formatting and submission adherence to achieve even better results in future tasks. With the lessons learned, the group is better equipped to handle subsequent project phases effectively.

5.3 TASK 3: CHOOSING THE APPROPRIATE LAN DEVICES

5.3.1 The results from the task 3

1. the number of devices in each area

Work Area	Devices	Network Ports	Wi-Fi APs
Embedded Lab	30	34	1
Cisco Network Lab	30	34	1
General Purpose Lab 1	30	34	1

General Purpose Lab 2	30	34	1
Classroom 1	30	34	1
Classroom 2	30	34	1

List3 the number of devices in each area

2. Equipment Selection and Costs

2.1 Lab and Classroom Workstations

Each lab and classroom will be equipped with 30 devices, totaling 180 devices:

- Model: Dell OptiPlex 7000 SFF
- Unit Price: RM 3,000
- Total Cost: RM 3,000 × 180 = RM 540,000

2.2 Cisco Network Lab Equipment

- Switch Model: Cisco Catalyst 9200 × 4
- Unit Price (Switch): RM 12,000
- Router Model: Cisco ISR 4000 × 1
- Unit Price (Router): RM 25,000
- Total Cost: (RM 12,000 × 4) + RM 25,000 = RM 73,000

2.3 Embedded Lab Equipment

- Model: Raspberry Pi 4 Model B + Sensor Peripheral Kits
- Unit Price: RM 1,500
- Total Units: 30 sets
- Total Cost: RM 1,500 × 30 = RM 45,000

2.4 Classroom Equipment

Each classroom will support hybrid teaching:

- Equipment: Smart Whiteboard + HD Camera + Audio System
- Unit Price: RM 16,000 (per set)
- Total Units: 2 sets
- Total Cost: RM 16,000 × 2 = RM 32,000

2.5 Wi-Fi Coverage

- Model: Cisco Catalyst 9100 Access Point
- Unit Price: RM 5,500
- Total Units: 6 (1 per area)
- Total Cost: RM 5,500 × 6 = RM 33,000

3. Network Security Requirements and Equipment Selection

3.1 Security Measures

1. Network Segmentation and Subnetting: Use VLANs to isolate labs, classrooms, and public areas, reducing broadcast domains and enhancing security.
2. Firewalls and Intrusion Detection: Deploy Next-Generation Firewalls (NGFW) and Intrusion Detection/Prevention Systems (IDS/IPS) to defend against potential threats in real time.
3. Authentication and Access Control: Use Network Access Control (NAC) systems to enforce device and user-based access policies.
4. Data Encryption and VPN: Implement SSL/TLS encryption for sensitive data and deploy VPNs for secure remote access.
5. Logging and Monitoring: Use Security Information and Event Management (SIEM) systems to collect and analyze network logs, ensuring quick threat detection and response.

3.2 Security Equipment and Costs

Equipment Type	Model/Specifications	Purpose	Unit Price	Quantity	Total Price

			(RM)		(RM)
Next-Generation Firewall	Fortinet FortiGate 100F	Provides real-time threat protection	20,000	1	20,000
IDS/IPS	Cisco Firepower 1120	Detects and blocks network attacks	18,000	1	18,000
Network Access Control	Aruba ClearPass	Enforces access control policies	15,000	1	15,000
VPN Appliance	Cisco AnyConnect VPN Appliance	Enables secure remote access	12,000	1	12,000
SIEM System	Splunk Enterprise	Centralizes log management and analysis	25,000	1	25,000
Advanced Switch (VLAN)	Cisco Catalyst 9300	Supports VLANs and enhances security	15,000	4	60,000

List4. Security Equipment and Costs

Total Cost: RM 150,000

4. Cabling Costs

4.1 Horizontal Cabling

- Type: Cat6 Network Cable
- Length: 150 meters per area × 6 areas = 900 meters
- Unit Price: RM 3/m
- Total Cost: RM 3 × 900 = RM 2,700

4.2 Vertical Cabling

- Type: OM4 Fiber Cable

- Length: 50 meters (backbone)
- Unit Price: RM 15/m
- Total Cost: RM 15 × 50 = RM 750

5. Total Cost Summary

Item	Quantity	Unit Price (RM)	Total Cost (RM)
Lab and Classroom Workstations	180 units	3,000	540,000
Cisco Network Lab Equipment	4 switches + 1 router	-	73,000
Embedded Lab Equipment	30 sets	1,500	45,000
Classroom Equipment	2 sets	16,000	32,000
Wi-Fi Access Points	6 units	5,500	33,000
Network Security Equipment	-	-	150,000
Cat6 Horizontal Cabling	900 meters	3	2,700
OM4 Vertical Cabling	50 meters	15	750
Total			RM 876,450

List5. Total Cost Summary

6. Feasibility Analysis

Budget and Remaining Amount

- Total Budget: RM 1,300,000
- Total Cost: RM 876,450
- Remaining Budget: RM 1,300,000 - RM 876,450 = RM 423,550

Conclusion

This design provides high-performance devices, reliable network infrastructure, and comprehensive security measures for 4 labs and 2 classrooms while staying within the budget. The remaining funds ensure flexibility for future expansions and upgrades, supporting the Faculty’s long-term needs.

2. Reflection Questions

1. **Are you surprised by the prices? How were you surprised?**

Yes, the prices for enterprise-grade networking devices, particularly routers and switches, were higher than initially expected. For example, the Cisco ISR 4000 router costs RM 25,000, which is significantly more than consumer-grade routers. However, the high cost reflects the advanced capabilities, scalability, and reliability required for academic environments.

2. **Have you ever considered cost as a factor for choosing networking devices?**

Initially, performance and functionality were the primary considerations. However, as the project progressed, cost became an essential factor due to budget constraints. The team had to carefully balance quality and affordability, choosing devices that offered the best performance-to-cost ratio.

3. **What are the major differences between the same devices from different brands?**

Cisco vs. Huawei Routers: Cisco devices provide better scalability, support for advanced features (e.g., AI-driven management, enhanced VLAN support), and superior reliability. Huawei routers, while more affordable, lack some enterprise-level capabilities and have less robust support systems.

Switches: Cisco Catalyst switches excel in performance and durability, making them ideal for academic institutions. Competitors like TP-Link offer budget-friendly options but are more suitable for small businesses rather than high-density networks.

5.3.2. Reflections on Task 3

1. Effectiveness of Device Selection and Process

During Task 3, Liu Wanpeng and the group conducted research, selected devices, and justified their choices based on the needs of Universiti Teknologi Malaysia’s academic building. The process involved evaluating network requirements, comparing devices, and finalizing a comprehensive list. Reflecting on the process:

- **Effective Decisions:**

The team identified key device categories, including routers, switches, access points, and security systems, ensuring all critical components of the LAN were covered.

Devices such as the Cisco ISR 4000 series routers and Cisco Catalyst 9200 series switches were selected based on their compatibility with high-performance academic networks, VLAN support, and scalability.

Wi-Fi 6 access points (Cisco Catalyst 9100) were chosen to address high-density usage in classrooms and labs, meeting modern connectivity standards.

- **Challenges Faced:**

Initial difficulty in balancing performance and cost while selecting devices. For instance, high-end Cisco devices offered superior performance but were significantly more expensive compared to brands like Huawei.

Some team members initially underestimated the importance of network security devices like next-generation firewalls. After further research and discussion, the Cisco ASA 5500-X series was chosen to ensure robust threat detection and mitigation.

- **Missed Opportunities:**

The team did not fully explore cost-saving alternatives for certain components, such as opting for more affordable backup systems or network management tools.

2. Challenges and Adjustments

1. **Surprise at Pricing:**
   Liu Wanpeng noted the high costs of enterprise-level networking devices. For example, the Cisco Catalyst 9100 Wi-Fi 6 access points cost RM 5,500 each, and the Cisco ISR 4000 routers were RM 25,000 per unit. While the prices were initially surprising, further analysis confirmed their market value and long-term reliability.

2. **Cost vs. Performance:**
   Balancing cost efficiency and performance was a significant challenge. Huawei devices were

considered for their affordability but ultimately deemed less suitable due to limited features and lower scalability compared to Cisco devices.

3. **Security Considerations:**
   The inclusion of advanced network security systems, such as AI-driven monitoring tools and next-generation firewalls, was initially overlooked. After discussing the risk of cyber threats in an academic setting, the team adjusted the budget to include robust security measures.

3. Key Lessons Learned

1. **Importance of Budgeting:**
   Researching device costs highlighted the need to allocate resources effectively, especially when working with a fixed budget. Allocating 50.5% of the total budget to hardware ensured the project's technical feasibility.

2. **Value of Brand Comparison:**
   Comparing Cisco and Huawei devices revealed significant differences in functionality, scalability, and cost. Cisco's enterprise-grade devices provided better support for academic institutions, while Huawei was more cost-effective for smaller setups.

3. **Comprehensive Planning:**
   Including backup systems, compliance measures, and monitoring tools ensured a holistic approach to network design, addressing both current and future needs.

4. Projected Marks Based on Rubrics

Using the marking rubric, the team's performance as follows:

Criteria	Score (1-5)	Reasoning
Device Selection	5	Comprehensive list with clear justifications for each device and its role in the network.
Cost Analysis	4	While costs were analyzed effectively, more emphasis on alternative options could improve it.

Research Depth	5	Extensive research was conducted, including market comparisons and functionality analysis.
Meeting Minutes	5	Detailed and specific, capturing key decisions and team contributions.
Adherence to Format	4	The report followed the required structure but lacked detailed reflections on mark projections.
Overall Score:	23/25	Strong technical depth and teamwork, with minor areas for improvement in cost-saving strategies.

List6 Projected Marks Based on Rubrics of task 4

5. Conclusion

Task 3 was a challenging but rewarding exercise in researching, evaluating, and selecting appropriate LAN devices. Liu Wanpeng and the team demonstrated the ability to balance technical requirements with budget constraints while addressing the specific needs of an academic institution. The experience reinforced the importance of comprehensive planning, in-depth research, and adaptive problem-solving in achieving project success.

5.4 TASK 4: MAKING THE CONNECTIONS – LAN and WAN

5.4.1 The results from the task 4

1. Work Areas on the Floor Plan

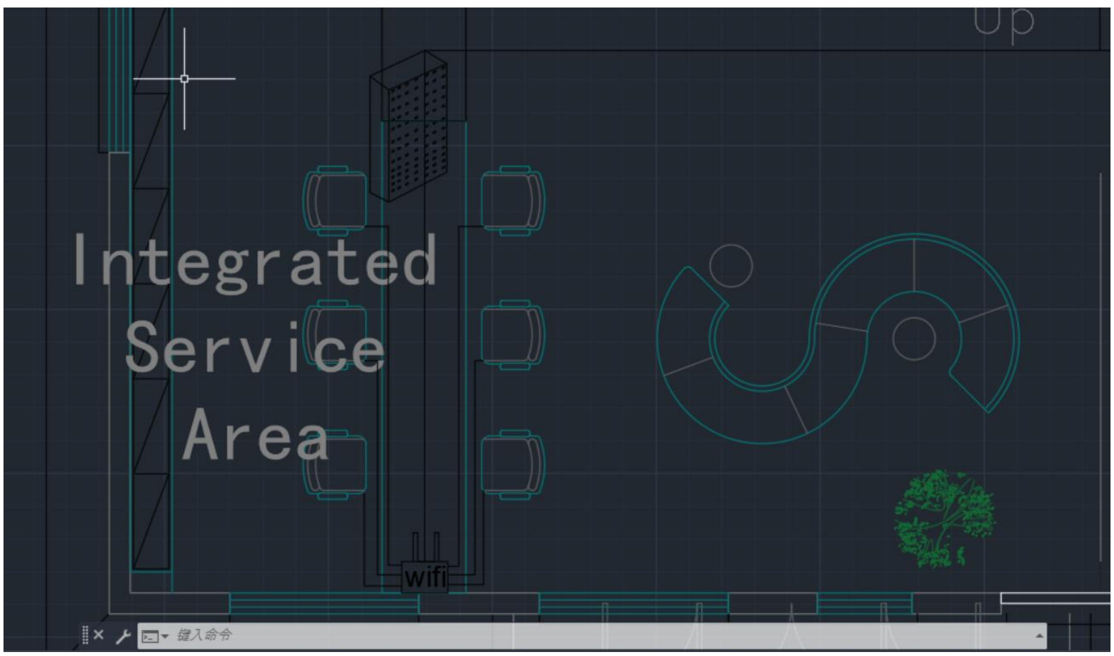
The identified work areas for the two-story academic building are as follows:

1. General Purpose Labs (2) – Used for diverse academic purposes, requiring high-speed connectivity for multiple devices.
2. Embedded Lab – Designed for IoT and sensor-related studies, requiring robust and reliable networking for data-heavy operations.
3. Cisco Networking Lab – Focused on networking education, requiring specific routers,

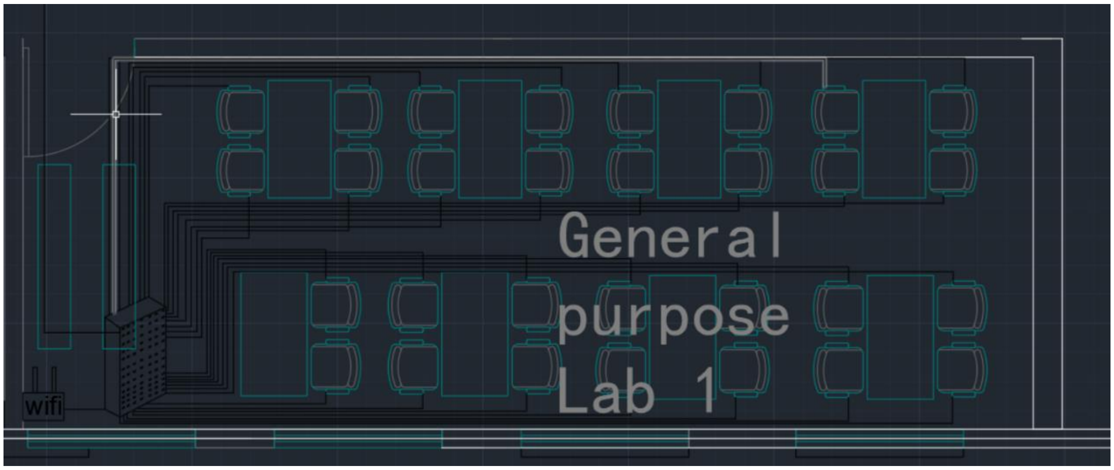
switches, and practical cabling setups.

4. Classrooms (2) – Require moderate connectivity for teaching purposes and Wi-Fi access points for seamless usage.
5. Teacher's Office (2) – Office spaces with dedicated connectivity.
6. Integrated Service Area – Central location for housing network servers, switches, and the main distribution facility (MDF).

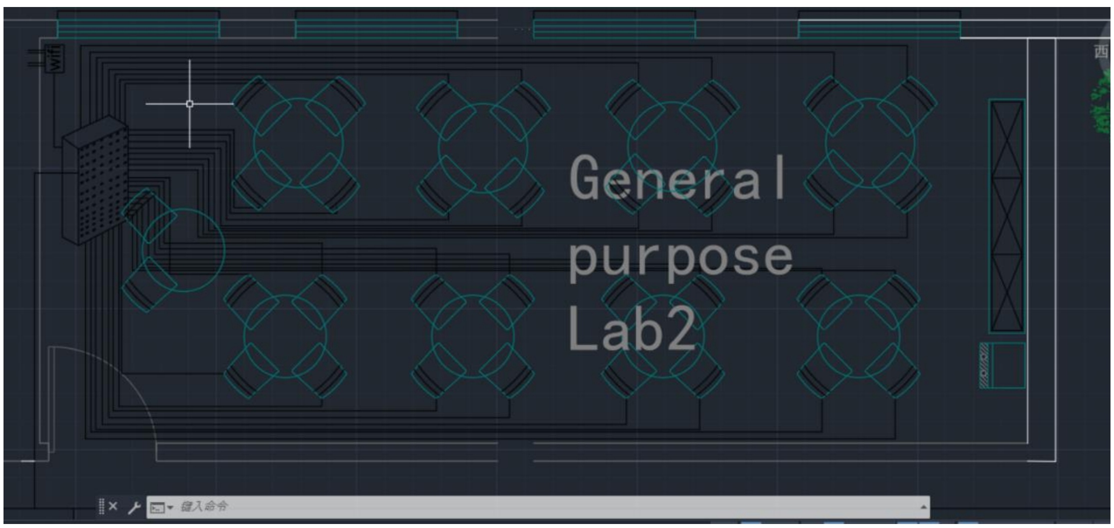
- First Floor:



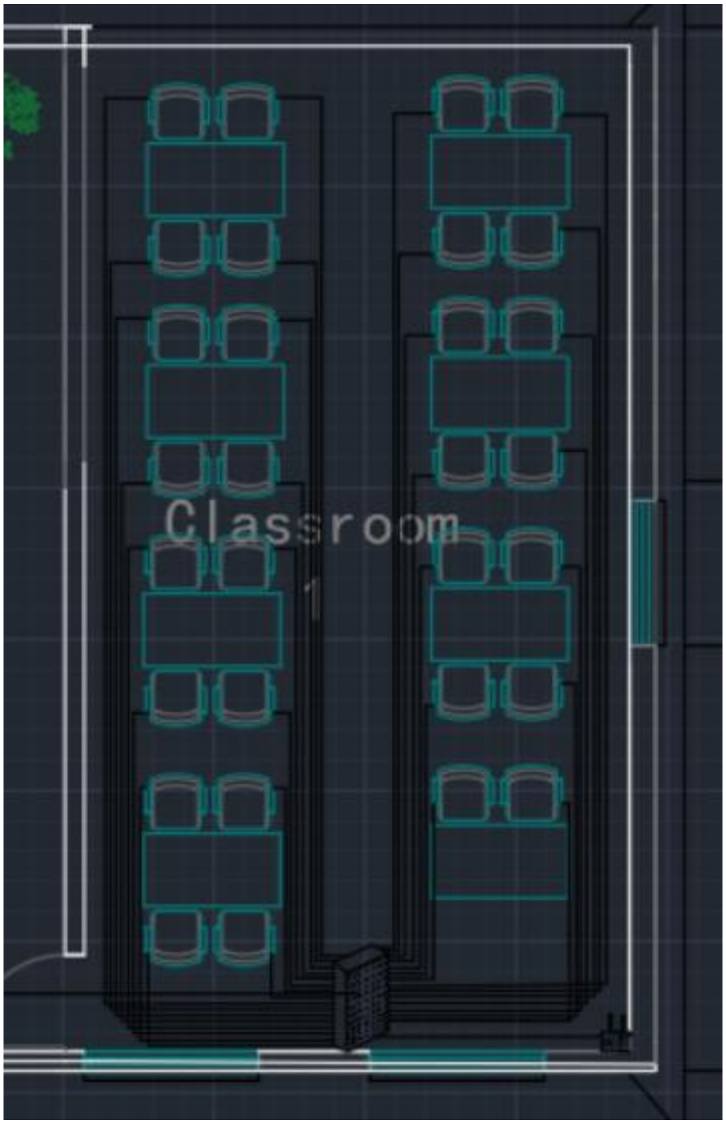
P3. Integrated Service Area (6 devices,1 switch, 1 Wi-Fi access point)



P4. General Purpose Lab 1 (30 devices, 1 switch, 1 Wi-Fi access point)



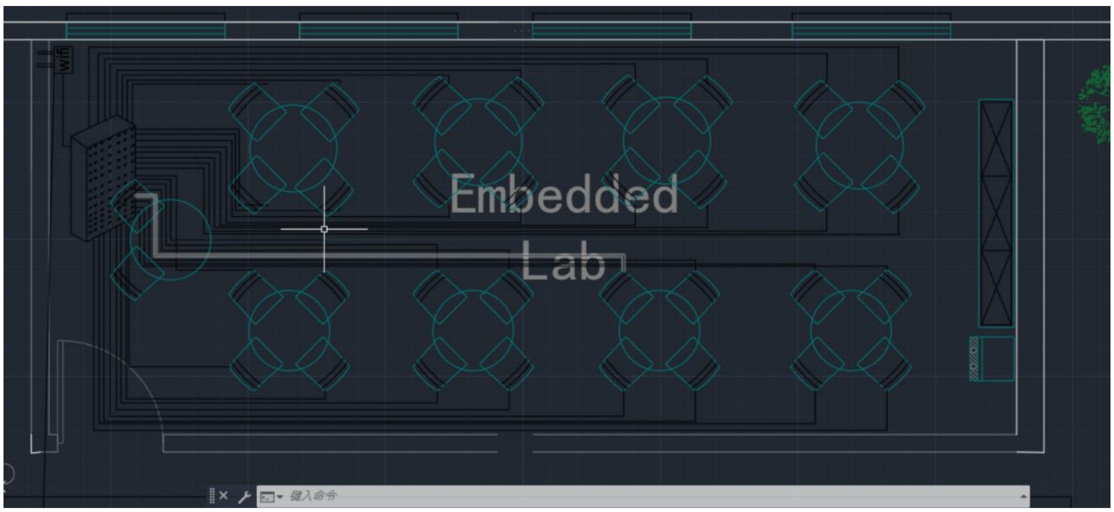
P5. General Purpose Lab 2 (30 devices, 1 switch, 1 Wi-Fi access point)



P6. Classroom 1 (30 devices, 1 switch, 1 Wi-Fi access point)

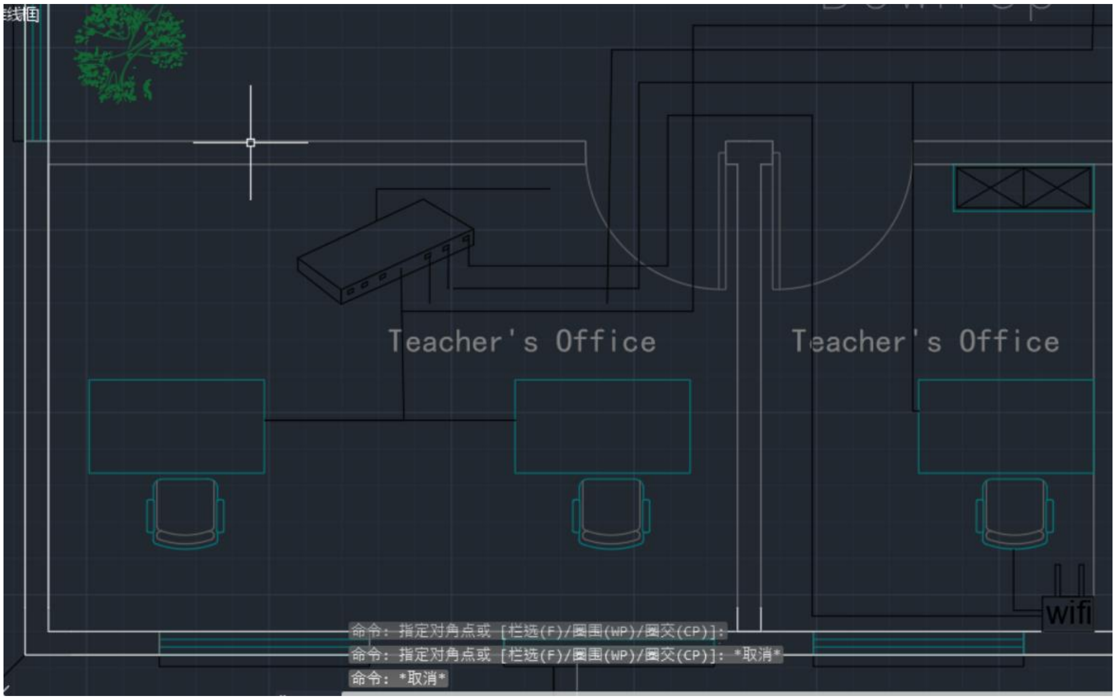
- Second Floor:

P7. Cisco Networking Lab (30 devices, 1 switch, 1 Wi-Fi access point)



P8. Embedded Lab (30 devices, 1 switch, 1 Wi-Fi access point)

P9. Classroom 2 (30 devices, 1 switch, 1 Wi-Fi access point)



P10. Teacher’s office(3 devices, 1 router, 1 Wi-Fi access point)

2. Connections, Patch Cords, and Switch Ports

- Each lab, classroom, and office is equipped with appropriate Ethernet connections to ensure stable performance.
- Patch cords (Cat 6A) are used to connect each end device to the Ethernet ports.
- The number of switch ports and patch cords per area is as follows:

Area	Connections	Patch Cords	Switch Ports
General Purpose Lab 1	30	30	34
General Purpose Lab 2	30	30	34
Embedded Lab	30	30	34
Cisco Networking Lab	30	30	34
Classrooms (2 total)	60	60	68

Teacher's Office (2 total)	4	4	8
Integrated Service Area	8	8	8

List7. The number of switch ports and patch cords per area

Cable Types and Lengths

1. Horizontal Cabling:

Type: Cat 6A Ethernet cables.

Purpose: To connect devices within the same floor to the respective switches.

Length: Calculated per area, with a 10% buffer for safety and adjustments.

Total Length:

- General Purpose Labs: 690m per lab.
- Cisco and Embedded Labs: 810m per lab.
- Classrooms: 900m total.
- Teacher's Offices: 40m total.
- Integrated Service Area: 30m.
- Grand Total: 3,290m × 1.10 = 3,619m.

2. Vertical Cabling:

Type: OM4 Fiber Optic cables.

Purpose: To connect floors and the MDF.

Length: 50m × 1.10 = 55m.

3. Choices and Justifications

Cable Types:

Cat 6A cables provide a balance between cost and performance for horizontal cabling, supporting 10Gbps speeds.

OM4 fiber ensures minimal latency and high-speed backbone connectivity.

Network Devices:

Switches: Cisco Catalyst 9200 Series selected for VLAN support and scalability.

Routers: Cisco ISR 4000 Series for robust routing and traffic management.

Wi-Fi Access Points: Cisco Catalyst 9100 Wi-Fi 6 for efficient high-density coverage.

Media Choices:

Fiber optic for backbone cabling ensures long-term scalability and performance.

Twisted-pair Ethernet cables are cost-effective for horizontal distribution.

5.4.2 Reflections on Task 4: Making the Connections – LAN and WAN

1. Effectiveness of the Infrastructure and Cabling Design

In Task 4, Thamer Alharbi and the team were tasked with finalizing the network infrastructure, including cabling types, lengths, device placements, and physical connections across various work areas. The process involved analyzing the CAD floor plan, calculating cable lengths, and ensuring proper interconnectivity for the LAN and WAN setup.

Effective Decisions:

- The team successfully identified all work areas (labs, classrooms, offices, and the Integrated Service Area) and calculated precise cable lengths with a 10% buffer for safety and future adjustments.
- Cat 6A Ethernet cables were chosen for horizontal cabling, balancing cost and performance, while OM4 fiber optic cables were selected for vertical backbone cabling, ensuring high-speed data transfer and scalability.
- The placement of switches, patch panels, and routers in accessible locations like the Integrated Service Area and within labs ensured ease of management and reduced cabling complexity.

Challenges Faced:

- Accurately measuring cable lengths, especially for areas with corners and elevation changes, was initially difficult. Feedback from Dr. Kaiyisah Hanis Binti Mohd Azmi highlighted the importance of factoring in these additional lengths.
- Some team members underestimated the complexity of integrating horizontal and vertical cabling, particularly in ensuring minimal latency between floors and efficient switch utilization.

Missed Opportunities:

- While the design considered scalability, the team did not explore alternative cabling types (e.g., Cat 8 cables for future-proofing) due to budget constraints. This could have been a worthwhile consideration given the rapid technological advancements.

2. Challenges and Adjustments

Feedback from the Instructor:

- Scale and Placement: Dr. Kaiyisah emphasized the importance of maintaining accurate scales in the CAD drawings and ensuring device placements aligned with the practical cabling routes. Initial sketches had minor inconsistencies in scale, which were promptly corrected.
- Cable Length Calculations: The team initially underestimated the total lengths required, particularly for the Embedded Lab and Cisco Lab, which had complex layouts. After reviewing the feedback, recalculations were done to account for these factors, improving the accuracy of the design.

Adjustments Made:

- Cable lengths for each area were revised to include additional lengths for corners, elevation, and routing through walls. The 10% buffer was strictly applied to ensure there was no shortage during implementation.
- Switch port configurations were optimized to prevent underutilization and ensure each device had a dedicated connection.

3. Key Lessons Learned

The Importance of Precision:

- Accurate measurements and calculations are crucial in network design. Overlooking even minor details, such as additional cable lengths for elevation changes, can result in significant delays and increased costs.

Comprehensive Planning:

- The need to align device placements with physical cabling routes highlighted the importance of integrating design and infrastructure planning early in the process.

Budget Constraints and Optimization:

- Balancing performance and cost remains a critical challenge. While Cat 6A cables were cost-effective, exploring Cat 8 for backbone cabling could have been a worthwhile investment for future-proofing.

4. Projected Marks Based on Rubrics

Item	Marks	Reasoning
Connections, Patch Cord, Switch Port Identified	2	All connections, patch cords, and switch ports were clearly identified and documented.
Cable Length and Types Identified	2	Detailed calculations of cable lengths with adjustments for corners and elevation.
Choices are Suitable and Appropriate	2	The selected cabling types and devices meet project requirements and ensure scalability.
Sketch of PC and Network Device Arrangement (+Cable)	3	Accurate and labeled CAD drawings reflecting physical placements and cable routing.
Scale: Is Appropriate	1	Correct scales were applied after addressing initial feedback from the instructor.

Total	10	Thorough execution of task requirements with minimal areas for improvement.

List8. Projected Marks Based on Rubrics of task 4

5. Overall Reflection

Task 4 was a comprehensive exercise in integrating physical and logical network designs. Thamer Alharbi demonstrated strong technical and analytical skills in calculating cable lengths, selecting appropriate media, and ensuring device placements aligned with practical constraints. While feedback from Dr. Kaiyisah revealed initial shortcomings in measurements and scaling, these issues were addressed promptly, resulting in a polished and functional network design.

The experience reinforced the importance of precision, adaptability, and proactive communication in large-scale projects. The lessons learned from this task will serve as a foundation for future challenges in network infrastructure design.

5.5. TASK 5: IP ADDRESSING SCHEME

5.5.1 The results from the task 5

1. Overview

The task involves designing an IP addressing scheme for the two-story academic building, ensuring each lab, classroom, and office has unique IP addresses. The scheme is based on the assigned network address and follows logical and efficient subnetting practices. This ensures reliable connectivity and avoids IP address conflicts.

2. Assigned Network Address

Group Assigned Network Address: 192.20.0.0/8

Subnet Mask: 255.224.0.0

3. Subnetting Calculations

Requirement Analysis:

- Total identified areas (labs, classrooms, and offices): 8
  (4 labs, 2 classrooms, and 2 offices)
- Each area must support 30 devices, plus a buffer for future scalability.

Step-by-Step Subnet Calculation:

1. Determine Subnet Size:
   Each subnet must accommodate 30 devices. To provide sufficient IPs, each subnet will have 2^5 = 32 addresses, with 30 usable addresses.
2. Reserved Bits:
   Starting from a /8 network, 13 bits were borrowed to create subnets, resulting in a /21 subnet mask.
3. Subnet Breakdown:
   Each subnet will support up to 2048 (2^11) hosts, providing adequate room for future expansion.

4. Subnet Allocation

Detailed IP Assignment:

Area	Subnet No.	Network Address	Broadcast Address	Usable IP Range	Subnet Mask
Lab 1	1	192.20.0.0	192.20.31.255	192.20.0.1 - 192.20.31.254	255.224.0.0
Lab 2	2	192.20.32.0	192.20.63.255	192.20.32.1 - 192.20.63.254	255.224.0.0
Lab 3	3	192.20.64.0	192.20.95.255	192.20.64.1 - 192.20.95.254	255.224.0.0
Lab 4	4	192.20.96.0	192.20.127.255	192.20.96.1 - 192.20.127.254	255.224.0.0

Classroom 1	5	192.20.128.0	192.20.159.255	192.20.128.1 - 192.20.159.254	255.224.0.0
Classroom 2	6	192.20.160.0	192.20.191.255	192.20.160.1 - 192.20.191.254	255.224.0.0
Office 1	7	192.20.192.0	192.20.223.255	192.20.192.1 - 192.20.223.254	255.224.0.0
Office 2	8	192.20.224.0	192.20.255.255	192.20.224.1 - 192.20.255.254	255.224.0.0

List9. Detailed IP Assignment:

5. Key Considerations

1. Scalability:
   Each subnet has sufficient room for expansion, accommodating future devices or additional requirements.
2. Simplicity and Logic:
   Subnets are assigned sequentially, making management and troubleshooting easier.
3. Future-proofing:
   Reserved IP ranges provide flexibility for unforeseen growth in device numbers or new areas.

6. Feedback and Adjustments

Instructor Feedback:

1. Ensure all calculations and subnetting details are clearly presented.
2. Address the scalability requirement by reserving adequate IPs for future expansion.
3. Label and organize the IP scheme for clarity.

Adjustments Made:

- All subnetting calculations were revisited to verify accuracy.

- The IP allocation table was refined to include all necessary details.

5.4.2 Reflections on TASK 5: IP ADDRESSING SCHEME

1. Effectiveness of Subnetting and IP Allocation

During Task 5, Liu Wanpeng and the group undertook the task of designing a detailed IP addressing scheme for the two-story academic building at Universiti Teknologi Malaysia (UTM). The focus was on meeting current requirements while allowing for future scalability. Reflecting on the process, the team demonstrated several strengths while also addressing challenges highlighted by Dr. Kaiyisah Hanis Binti Mohd Azmi.

Effective Decisions:

1. Logical Subnetting:
    - The team effectively utilized the assigned network address (192.20.0.0/8) to create subnets tailored to the needs of labs, classrooms, and offices.
    - Each subnet was designed with a /21 mask, providing sufficient addresses while avoiding wastage.
2. Clear and Detailed Documentation:
    - All subnet calculations, including network, broadcast, and usable IP ranges, were meticulously labeled and organized in a clear table.
    - The documentation included detailed workings that aligned with the feedback received.
3. Focus on Scalability:
    - Subnets were allocated with extra capacity to accommodate future devices or additional rooms, ensuring the network remains scalable.

2. Challenges and Adjustments

Challenges Faced:

1. Initial Miscalculations:
    - Early drafts of the subnetting scheme contained errors in calculating the usable IP ranges for certain areas. This was identified during review sessions.
2. Balancing Subnet Sizes:
    - Determining the optimal subnet size to balance current needs and future scalability without wasting addresses required several iterations.

Instructor Feedback and Adjustments:

1. Feedback from Dr. Kaiyisah:
    - Comment: "Ensure all calculations are complete, clearly labeled, and logical. Provide detailed IP assignment for every lab and room."
    - Efforts in Response: Liu Wanpeng led the team in revisiting and refining the calculations, ensuring that every step was explicitly labeled. Special attention was given to documenting IP ranges and broadcast addresses for each subnet.
2. Revised Documentation:
    - Following the feedback, the team updated the report to include detailed visual aids, such as subnet allocation tables, to enhance clarity and readability.
3. Focus on Future Proofing:
    - Adjustments were made to reserve additional IP ranges for scalability, ensuring the network remains flexible as demands increase.

3. Key Lessons Learned

1. Responsiveness to Feedback:
    - The importance of addressing instructor feedback thoroughly was evident. Liu Wanpeng ensured the team incorporated all suggestions from Dr. Kaiyisah, improving both the technical accuracy and presentation of the work.
2. Precision and Clarity:

- Accurate and well-documented subnetting is essential for successful implementation. This task reinforced the need for clear labeling and logical structuring in technical reports.

3. Proactive Problem-Solving:

    - Anticipating future needs and designing for scalability are crucial for long-term network performance.

4. Projected Marks Based on Rubric

Criteria	Marks	Reasoning
Use Correct Network Address for Group	1	Correctly utilized the assigned network address (192.20.0.0/8).
Workings Provided Clearly and Labelled	4	Comprehensive calculations with detailed labels and clear logical flow.
IP Division is Appropriate and Logical	1	Subnetting was logical, balancing scalability and efficiency.
Complete Detail of All IP Assignment	4	Detailed IP assignment for all labs and rooms, covering network, broadcast, and usable ranges.
Total	10	All rubric criteria were met, reflecting thoroughness and responsiveness to feedback.

List10. Projected Marks Based on Rubric

5. Conclusion

Task 5 showcased Liu Wanpeng's leadership in ensuring a robust and scalable IP addressing scheme. With guidance from Dr. Kaiyisah Hanis Binti Mohd Azmi and through iterative problem-solving, the team successfully designed a comprehensive and future-proof network. The experience underscored the value of clear documentation, logical planning, and adapting to constructive feedback to deliver high-quality results.

6. Conclusion

Achievements

Throughout the completion of Tasks 1 through 5 for this project, we have demonstrated significant progress in understanding and implementing network design concepts. Below are the major achievements that reflect the team's efforts and capabilities:

1. **Comprehensive Planning and Execution:**
   - Successfully designed a scalable and secure network infrastructure for Universiti Teknologi Malaysia's academic building. This included a robust IP addressing scheme, device selection, and LAN/WAN connections.
   - Ensured that the design aligns with the case study requirements, including specific needs for four labs, classrooms, and office spaces.
2. **Technical Proficiency:**
   - Accurately implemented subnetting calculations to ensure logical and future-proof IP address allocation for all functional areas.
   - Chose high-performance network devices, such as Cisco Catalyst switches and Wi-Fi 6 access points, ensuring optimal functionality and compatibility with modern academic needs.
3. Adaptation to Feedback:
   - Responded to feedback from Dr. Kaiyisah Hanis Binti Mohd Azmi with continuous iterations and improvements, particularly regarding CAD drawings, IP addressing, and network layout. This helped us address errors and produce a polished final submission.
   - Incorporated teacher suggestions into better documentation, clearer calculations, and

improved resource allocation.

4. Collaboration and Documentation:
    - Maintained clear and specific meeting minutes, ensuring proper team communication and accountability.
    - Presented detailed, logically structured reports for each task, adhering to formatting and academic standards.

Strengths

1. Teamwork and Leadership:
    - Under the leadership of Liu Wanpeng, the team effectively delegated tasks and maintained a collaborative environment, leading to the timely completion of deliverables.
    - The group displayed strong cohesion, leveraging each member's unique skills to solve problems efficiently.
2. Attention to Detail:
    - Careful adherence to the project requirements, including scaling the CAD floor plan accurately and matching network design elements to the building layout.
3. Forward-thinking Design:
    - The network plan is not only tailored to current needs but also anticipates future growth, with adequate IP address allocation, scalable device configurations, and consideration for emerging technologies.

Weaknesses

1. Initial Oversights:
    - Early stages of Task 1 and Task 2 highlighted gaps in understanding project requirements, particularly regarding the CAD design and floor layout. This led to rework, which could have been avoided with better initial analysis.

- Cost considerations in Task 3 could have been more thoroughly evaluated. While we selected high-performance devices, we missed opportunities to explore more cost-effective alternatives.

2. Time Management:
    - Some tasks were delayed due to iterative corrections after feedback. This exposed the need for stronger initial planning and review processes to minimize errors.
3. Limited Exploration of Alternatives:
    - While Cisco devices were chosen for their reliability and features, there was less exploration of competing brands, such as Huawei, which could have offered cost benefits.

Suggestions for Project Improvement

1. Early Stakeholder Engagement:
    - Conduct more thorough discussions with stakeholders (e.g., lecturers, team members) at the project's outset to clarify all requirements and expectations. This can reduce rework and ensure alignment from the start.
2. Enhanced Research Depth:
    - Allocate more time for researching alternative devices, cabling solutions, and network designs to identify cost-effective and innovative options without compromising quality.
3. Improved Time Management:
    - Establish stricter internal deadlines for task completion and review, allowing sufficient time to incorporate feedback without impacting overall project progress.
4. Structured Feedback Integration:
    - Implement a systematic approach to addressing feedback by categorizing it into priority levels. This ensures critical issues are resolved promptly while minimizing

disruptions to the workflow.

5. Documentation and Communication:
    - Ensure all reports and presentations are structured clearly and provide actionable insights for readers. Focus on presenting technical information in a way that is accessible to non-technical stakeholders as well.

Final Thoughts

The completion of this project has been a transformative learning experience. It allowed us to apply theoretical knowledge to a practical, real-world scenario while simultaneously improving our technical skills, teamwork, and problem-solving abilities. Under the guidance of Dr. Kaiyisah Hanis Binti Mohd Azmi, we not only achieved the project goals but also developed critical competencies that will benefit us in future academic and professional endeavors.

While there were challenges and areas for improvement, the lessons learned from each task have strengthened our ability to manage complex projects effectively. Moving forward, we aim to apply these lessons to enhance our planning, execution, and adaptability in future undertakings.

7. Additional Considerations for Client's Decision-Making Process

To aid the client in making informed decisions, it is important to analyze whether additional investments could lead to better quality outcomes for the network project. Below are the areas where a slightly increased budget could enhance the network's performance, scalability, and security.

1. Enhanced Network Security

Current Plan:

- The current network security relies on Cisco ASA 5500-X Series Next-Generation Firewalls and basic intrusion detection systems.

Recommendation:

- Upgrading to AI-powered adaptive security systems, such as Cisco Secure Firewall 3100 Series, could significantly improve threat detection and real-time response capabilities.

Feature	Current Plan	Recommended Upgrade	Cost Increase	Benefit
Threat Detection	Standard IDS/IPS	AI-driven behavior analytics	~RM 10,000/unit	Faster response to complex cyberattacks.
Real-Time Mitigation	Manual intervention	Automated response system	~RM 8,000/unit	Reduces downtime caused by cyber threats.

List11. Comparison of Network Security Upgrade Options

2. Wi-Fi Coverage and Density

Current Plan:

- Using Cisco Catalyst 9100 Wi-Fi 6 Access Points with standard density coverage.

Recommendation:

- Increasing the number of Wi-Fi 6 access points or upgrading to Cisco Catalyst 9136 models for improved coverage in high-density areas, especially in labs and classrooms.

Feature	Current Plan	Recommended Upgrade	Cost Increase	Benefit
Maximum User Capacity	200 devices per AP	300 devices per AP	~RM 2,500/unit	Supports growing user demand in the future.
Coverage Range	Standard (up to 40m indoor)	Extended range (up to 50m indoor)	~RM 1,500/unit	Reduces dead zones and improves connectivity.

List12. Wi-Fi Coverage and Density Upgrade Comparison Table

3. Scalability for Future Growth

Current Plan:

- The current design supports the expected 15% growth over the next 4 years but lacks flexibility for unforeseen expansions.

Recommendation:

- Incorporate modular switches like Cisco Catalyst 9500 Series, which allow port expansions and support 40G/100G uplinks for future growth.

Feature	Current Plan	Recommended Upgrade	Cost Increase	Benefit
Uplink Speed	10G uplinks	40G/100G uplinks	~RM 20,000/unit	Prevents bottlenecks as user demand grows.
Port Expandability	Fixed port count	Modular ports	~RM 15,000/unit	Enables easy upgrades without replacing hardware.

List13. Scalability Upgrade Comparison Table

4. Data Storage and Backup

Current Plan:

- The current plan uses a basic local backup solution for file storage and recovery.

Recommendation:

- Adding a cloud-based storage solution, such as Amazon AWS or Microsoft Azure, for secure and scalable data backup.

Feature	Current Plan	Recommended Upgrade	Cost Increase	Benefit
Storage Method	Local storage only	Hybrid (local + cloud)	~RM 5,000/year	Protects data from physical disasters.
Data Access	On-site only	Anywhere, anytime	~RM	Improves flexibility and

		access	2,000/year	collaboration.

List14. Data Storage and Backup Solution Comparison Table

5. Cabling and Infrastructure

Current Plan:

- Using Cat6 cables for horizontal cabling and OM4 fiber optics for vertical cabling.

Recommendation:

- Upgrading to Cat6A cables for horizontal cabling, providing higher performance and future-proofing the network.

Feature	Current Plan	Recommended Upgrade	Cost Increase	Benefit
Data Rate	10Gbps	10Gbps (better shielding)	~RM 1,000/km	Reduces crosstalk and interference.
Maximum Distance	100m	100m	Minimal	Enhanced reliability in high-demand areas.

List15. Cabling and Infrastructure Upgrade Comparison Table

Summary

Implementing these upgrades would lead to a better-quality network capable of handling current and future demands. The additional costs are justified by the significant long-term benefits in terms of performance, security, and scalability. Below is an estimated cost-benefit summary:

Category	Estimated Additional Cost (RM)	Impact
Enhanced Security	30,000	Reduced risk of cyberattacks.
Wi-Fi Upgrades	10,000	Better user experience and coverage.

Scalability	35,000	Future-proof design for growth.
Data Backup	7,000/year	Improved data safety and accessibility.
Cabling Infrastructure	5,000	Reliable high-speed connectivity.
Total	~87,000 (+ 7,000/year)	Comprehensive improvements across all areas.

List16. Additional Investment Cost-Benefit Summary Table

Conclusion

While the current design meets all project requirements, these additional investments can significantly enhance the network's reliability, performance, and scalability. For a slightly higher budget, Universiti Teknologi Malaysia could achieve a network infrastructure that is not only robust but also future-proof, ensuring a seamless experience for its growing academic community.

8. Team Members and responsibilities

LiuWanpeng's Contributions

1. First-Floor Layout Design:
    - I was responsible for designing the network layout for the first floor, including general-purpose labs, the integrated service area, and the rest area.
    - Used CAD floor plan tools to plan device placement and cabling paths, ensuring efficient network coverage and minimal material wastage.
    - For the integrated service area, as the core of network management, I carefully designed the placement and connections of key devices such as routers, switches, and firewalls.

2. Report Writing and Proofreading:
    - As the group leader, I was responsible for drafting and organizing the main sections of the final report, including summarizing the project results, cost analysis, and recommendations for future improvements.
    - Conducted multiple rounds of proofreading to ensure the report's language was fluent and the technical data was accurate.
3. Meeting Facilitation and Task Coordination:
    - I chaired all five group meetings, from project initiation to submission, clearly assigning tasks and supervising progress.
    - Resolved team disagreements regarding IP allocation schemes and budget priorities, reaching consensus effectively.

Zhao Wei's Contributions

1. :
    - Responsible for the second-floor network layout, covering the embedded lab, CISCO lab, classroom, and administrative offices.
    - Proposed forward-looking IP address allocation schemes and designed VLAN segmentation logic to enhance network security and manageability.
    - Provided professional insights into the technical aspects of the report and validated VLAN and security configurations.

Thamer Alharbi's Contributions

1.
    - Focused on the design of IoT and networking labs, selecting and evaluating high-performance IoT equipment and lab hardware.
    - Conducted cost analysis, ensuring the project was completed within budget while reserving 10% as a contingency fund for unforeseen expenses.

- Provided in-depth analysis of device performance and costs, contributing detailed insights to the final device selection.

For more details, please refer to the Minutes in the appendix.

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[12] T. Olsson, K. Artto, A. Hauhia, and S. Kivinen, ‘When project outcomes matter: Organizational integration in managing long-term target benefits’, *Int. J. Proj. Manag.*, vol. 42, no. 8, p. 102648, Nov. 2024, doi: 10.1016/j.ijproman.2024.102648.

10. Appendices.

10.1 Meeting

1. Meeting One

MEETING MINUTES

DATE/TIME	*October 10, 2024 10:00 AM*
LOCATION	*Zoom Virtual Meeting*
AGENDA	*Role Assignment and Initial Design Discussion*
Meeting MC	*Liu Wanpeng*
ATTENDANCE	

NAME		**TIME**	**REASON FOR ABSENCE**
Liu Wanpeng		*10:00*	
Zhao Wei		*10:10*	
Thamer Alharbi		*10:06*	
MINUTES			
NO.	**ITEM DISCUSSED**	**IDEAS/SUGGESTIONS AND PERSON GIVING IT**	**PERSON IN CHARGE & DATE**
1	*Role Assignment*	*Liu, Zhao, and Thamer discussed roles based on skills.*	*Liu (10/10)*
2	*Initial Design Concepts*	*Each member presented initial layout ideas.*	*Zhao (12/10)*
3	*Next Steps*	*Prepare preliminary sketch by the next meeting.*	*Liu(12/10)*
4	*Meeting ended*	*11:00*	

Meeting on Scoring Sheet

Liu Wanpeng

No.	Scoring Criteria	Score (1-5)
1	Host's Performance	5
2	Clarity of Agenda	5
3	Team Participation	4.5
4	Decision-Making Efficiency	4.5
5	Task Allocation	5
6	Overall score	5

Zhao Wei

No.	Scoring Criteria	Score (1-5)
1	Host's Performance	4
2	Clarity of Agenda	4.5
3	Team Participation	4.5
4	Decision-Making Efficiency	4
5	Task Allocation	3
6	Overall score	5

Thamer Alharbi

No.	Scoring Criteria	Score (1-5)

1	Host's Performance	3.5
2	Clarity of Agenda	4
3	Team Participation	4
4	Decision-Making Efficiency	5
5	Task Allocation	3.5
6	Overall score	4.5

2． Meeting Two

MEETING MINUTES

DATE/TIME	*October 12, 2024 10:00 AM*	
LOCATION	*Zoom Virtual Meeting*	
AGENDA	*Floor Plan Review and Feedback*	
Meeting MC	*Liu Wanpeng*	
ATTENDANCE		
NAME	**TIME**	**REASON FOR ABSENCE**
Liu Wanpeng	*10:00*	
Zhao Wei	*10:07*	
Thamer Alharbi	*10:09*	
MINUTES		

NO.	ITEM DISCUSSED	IDEAS/SUGGESTIONS AND PERSON GIVING IT	PERSON IN CHARGE & DATE
1	*Floor Plan Presentation*	*Each member presented their design sketches.*	*Liu (12/10)*
2	*Software to use*	*Liu – usw CAD to draw the Graphic design drawing*	*Liu (16/10)*
3	*Feedback Discussion*	*Members provided feedback and discussed improvements.*	*Zhao (14/10)*
4	*Design Revisions*	*Revise designs based on feedback for the next meeting.*	*Thamer (14/10)*
5	*Meeting ended*	*11:00*	

Meeting Two Scoring Sheet

Liu Wanpeng

No.	Scoring Criteria	Score (1-5)
1	Host's Performance	5

2	Clarity of Agenda	5
3	Team Participation	5
4	Decision-Making Efficiency	5
5	Task Allocation	4.5
6	Overall score	5

Zhao Wei

No.	Scoring Criteria	Score (1-5)
1	Host's Performance	4
2	Clarity of Agenda	4
3	Team Participation	4
4	Decision-Making Efficiency	3.5
5	Task Allocation	3
6	Overall score	4

Thamer Alharbi

No.	Scoring Criteria	Score (1-5)
1	Host's Performance	4.5
2	Clarity of Agenda	4
3	Team Participation	4

4	Decision-Making Efficiency	3.5
5	Task Allocation	4
6	Overall score	4.5

3. Meeting Three

MEETING MINUTES

<table>
<tr><td colspan="2">DATE/TIME</td><td colspan="2">October 14, 2024 10:00 AM</td></tr>
<tr><td colspan="2">LOCATION</td><td colspan="2">Zoom Virtual Meeting</td></tr>
<tr><td colspan="2">AGENDA</td><td colspan="2">Final Review and Report Preparation</td></tr>
<tr><td colspan="2">Meeting MC</td><td colspan="2">Liu Wanpeng</td></tr>
<tr><td colspan="4">ATTENDANCE</td></tr>
<tr><td colspan="2">NAME</td><td>TIME</td><td>REASON FOR ABSENCE</td></tr>
<tr><td colspan="2">Liu Wanpeng</td><td>10:00</td><td></td></tr>
<tr><td colspan="2">Zhao Wei</td><td>10:11</td><td></td></tr>
<tr><td colspan="2">Thamer Alharbi</td><td>10:13</td><td></td></tr>
<tr><td colspan="2"></td><td></td><td></td></tr>
<tr><td colspan="4">MINUTES</td></tr>
<tr><td>NO.</td><td>ITEM DISCUSSED</td><td>IDEAS/SUGGESTIONS AND PERSON GIVING</td><td>PERSON IN CHARGE & DATE</td></tr>
</table>

		IT	
1	*Final Design Review*	*Final design adjustments were reviewed.*	*Liu (16/10)*
2	*Report Writing Discussion*	*Members discussed report content and structure.*	*Zhao (16/10)*
3	*Submission Preparation*	Prepare final report for submission.	*Thamer (16/10)*
4	*Meeting ended*	*11:00*	

Meeting Three Scoring Sheet

Liu Wanpeng

No.	Scoring Criteria	Score (1-5)
1	Host's Performance	5
2	Clarity of Agenda	4.5
3	Team Participation	5
4	Decision-Making Efficiency	5
5	Task Allocation	4.5
6	Overall score	5

Zhao Wei

No.	Scoring Criteria	Score (1-5)
1	Host's Performance	4
2	Clarity of Agenda	3
3	Team Participation	4
4	Decision-Making Efficiency	4.5
5	Task Allocation	3
6	Overall score	4.5

Thamer Alharbi

No.	Scoring Criteria	Score (1-5)
1	Host's Performance	4.5
2	Clarity of Agenda	5
3	Team Participation	4
4	Decision-Making Efficiency	4.5
5	Task Allocation	4
6	Overall score	5

4. Meeting Four

MEETING MINUTES

DATE/TIME	*October 29, 2024 7:00 PM*	
LOCATION	*Zoom Virtual Meeting*	
AGENDA	*Network Requirements Review and Further Analysis*	
Meeting MC	*Liu Wanpeng*	
ATTENDANCE		
NAME	**TIME**	**REASON FOR ABSENCE**
Liu Wanpeng	*10:00*	
Zhao Wei	*10:07*	
Thamer Alharbi	*10:07*	

MINUTES			
NO.	**ITEM DISCUSSED**	**IDEAS/SUGGESTIONS AND PERSON GIVING IT**	**PERSON IN CHARGE & DATE**
1	*Final Design Review*	*Discussed implementing AI-based monitoring tools.*	*Liu (29/10)*
2	*Budget Analysis*	*Proposed a phased budgeting*	*Zhao (31/10)*

		approach.	
3	Network Topology	Explored using mesh topology for high-demand areas.	Thamer (31/10)
4	*Meeting ended*	*8:30 PM*	

Meeting Four Scoring Sheet

Liu Wanpeng

No.	Scoring Criteria	Score (1-5)
1	Host's Performance	5
2	Clarity of Agenda	4.5
3	Team Participation	5
4	Decision-Making Efficiency	5
5	Task Allocation	5
6	Overall score	5

Zhao Wei

No.	Scoring Criteria	Score (1-5)
1	Host's Performance	4
2	Clarity of Agenda	5
3	Team Participation	4

4	Decision-Making Efficiency	4.5
5	Task Allocation	3.5
6	Overall score	4.5

Thamer Alharbi

No.	Scoring Criteria	Score (1-5)
1	Host's Performance	4.5
2	Clarity of Agenda	5
3	Team Participation	4
4	Decision-Making Efficiency	4.5
5	Task Allocation	3.5
6	Overall score	4.5

5. Meeting Five

MEETING MINUTES

DATE/TIME	*November 22, 2024 6:00 PM*
LOCATION	*Zoom Virtual Meeting*
AGENDA	4. *Overview of the Feasibility Analysis Report* 5. *Discussion on Key Budget and Technical*

		Feasibility 6. *Risk Assessment and Mitigation Strategies* 7. *Task Allocation and Timeline*	
Meeting MC		*Liu Wanpeng*	
ATTENDANCE			
NAME		**TIME**	**REASON FOR ABSENCE**
Liu Wanpeng		*06:00*	
Zhao Wei		*06:01*	
Thamer Alharbi		*06:06*	
MINUTES			
NO.	**ITEM DISCUSSED**	**IDEAS/SUGGESTIONS AND PERSON GIVING IT**	**PERSON IN CHARGE & DATE**
1	*Overview of the Feasibility Analysis Report*	*Zhao Wei suggested potential optimizations for the core hardware selection (e.g., Cisco ISR 4000 routers).*	*Zhao (26/11)*

2	*Discussion on Key Budget and Technical Feasibility*	*Liu Wanpeng emphasized the importance of hardware allocation, which constitutes 50.5% of the total budget.*	*Liu (25/11)*
3	*Risk Assessment and Mitigation Strategies*	*Thamer recommended strengthening the management of the contingency fund (70,000 RM) to address market price fluctuations.*	*Thamer (26/11)*
4	*Meeting ended*	*7:10 PM*	

Meeting on Scoring Sheet

Liu Wanpeng

No.	Scoring Criteria	Score (1-5)
1	Host's Performance	5
2	Clarity of Agenda	4
3	Team Participation	4.5
4	Decision-Making	4.5

	Efficiency	
5	Task Allocation	5
6	Overall score	5

Zhao Wei

No.	Scoring Criteria	Score (1-5)
1	Host's Performance	4
2	Clarity of Agenda	4.5
3	Team Participation	4.5
4	Decision-Making Efficiency	4
5	Task Allocation	5
6	Overall score	5

Thamer Alharbi

No.	Scoring Criteria	Score (1-5)
1	Host's Performance	4.5
2	Clarity of Agenda	4
3	Team Participation	4
4	Decision-Making Efficiency	5
5	Task Allocation	4

6	Overall score	4.5

6. Meeting Six

DATE/TIME|	November	10/12/ 2024	6:00PM
LOCATION|	Zoom Virtual Meeting		
AGENDA|	1. Discussion on cabling paths and lengths.		
	2.Confirmation of device placements.		
	3.Review of cost estimates and final adjustments.		
	4. Assignments for report preparation and submission.		
Meeting MC	Liu Wanpeng		

ATTENDANCE

NAME	TIME	REASON FOR ABSENCE
Liu Wanpeng	06:00	
Zhao Wei	06:01	
Thamer Alharbi	06:06	

NO.	ITEM DISCUSSED	IDEAS/SUGGESTIONS AND PERSON GIVING IT	PERSON IN CHARGE & DATE
1	Cabling Paths and Lengths	Zhao Wei proposed including additional safety margins for cabling redundancy.	Zhao (12/12)
2	Device Placements	Liu Wanpeng suggested ensuring device alignment with CAD layout for accuracy.	Liu (11/12)
3	Cost Estimates and Adjustments	Thamer recommended a thorough recheck of budget alignment with equipment needs.	Thamer (12/12)
	Cost Estimates and Adjustments	Liu coordinated report drafting responsibilities among team members.	Liu (13/12)

	Meeting Ended	Meeting concluded at 7:00 PM.	

Member Rating

Liu Wanpeng

No. Scoring Criteria	Score (1-5)
Host's Performance	5
Clarity of Agenda	4
Team Participation	4.5
Decision-Making Efficiency	4.5
Task Allocation	5
Overall score	5

Zhao Wei

No. Scoring Criteria	Score (1-5)
Host's Performance	5
Clarity of Agenda	4.5
Team Participation	4.5
Decision-Making Efficiency	4
Task Allocation	5
Overall score	5

Thamer Alharbi

No. Scoring Criteria Score (1-5)

1 Host's Performance 4.5

2 Clarity of Agenda 4

3 Team Participation 4

4 Decision-Making Efficiency 5

5 Task Allocation 3.5

6 Overall score 4.5

7. Meting Sven

MEETING MINUTES

DATE/TIME:	**December 18, 2024, 10:00 AM**
LOCATION:	Zoom Virtual Meeting
AGENDA:	Subnet Division, Device IP Assignment, and Report Planning
Meeting MC:	Liu Wanpeng

ATTENDANCE

NAME	TIME	REASON FOR ABSENCE
Liu Wanpeng	10:00	-
Zhao Wei	10:05	-
Thamer Alharbi	10:08	-

MINUTES

NO.	ITEM DISCUSSED	IDEAS/SUGGESTIONS AND PERSON GIVING IT	PERSON IN CHARGE & DATE
1	Subnet Division	Liu proposed using subnet masks /26, /28, and /30 based on device requirements and expansion buffer.	Liu (18/12)
2	Device IP Assignment	Zhao suggested allocating unique static IPs for routers, Wi-Fi APs, and storage servers.	Zhao (18/12)
3	Multi-Terabyte Storage Server Configuration	Thamer highlighted the importance of separating 1st and 2nd floor storage servers into distinct subnets.	Thamer (18/12)
4	Final Report Draft Planning	Liu assigned each team member a section of the report to finalize by December 22.	Liu (22/12)
5	Meeting Ended	Meeting concluded at 11:15 AM.	

Meeting on Scoring Sheet

NAME	SCORING CRITERIA	SCORE (1-5)
Liu Wanpeng	Host's Performance	5
	Clarity of Agenda	5
	Team Participation	4.5
	Decision-Making Efficiency	5
	Task Allocation	5
Overall Score		**5**

Zhao Wei	Host's Performance	4.5
	Clarity of Agenda	5
	Team Participation	4.5
	Decision-Making Efficiency	4.5
	Task Allocation	4.5
Overall Score		**4.5**
Thamer Alharbi	Host's Performance	4
	Clarity of Agenda	4.5
	Team Participation	4.5
	Decision-Making Efficiency	5
	Task Allocation	4
Overall Score		**4.5**

10.2 The financial budget

Comprehensive Revised Feasibility and Equipment Analysis Report

Group: 7

Budget: RM 1.3M

1. Identified Work Areas

Work Area	Devices	Network Ports	Wi-Fi APs
Embedded Lab	30	34	1

Cisco Network Lab	30	34	1
General Purpose Lab 1	30	34	1
General Purpose Lab 2	30	34	1
Classroom 1	30	34	1
Classroom 2	30	34	1

2. Equipment Selection and Costs

2.1 Lab and Classroom Workstations

- Model: Dell OptiPlex 7000 SFF
- Unit Price: RM 3,000
- Total Units: 180
- Total Cost: RM 3,000 × 180 = RM 540,000

2.2 Cisco Network Lab Equipment

- Switch Model: Cisco Catalyst 9200 × 4
- Router Model: Cisco ISR 4000 × 1
- Total Cost:
    - Switch: RM 12,000 × 4 = RM 48,000
    - Router: RM 25,000
    - Total: RM 73,000

2.3 Embedded Lab Equipment

- Model: Raspberry Pi 4 Model B + Sensor Peripheral Kits
- Unit Price: RM 1,500
- Total Units: 30

- Total Cost: RM 1,500 × 30 = RM 45,000

2.4 Classroom Equipment

- Equipment: Smart Whiteboard + HD Camera + Audio System
- Unit Price: RM 16,000 (per set)
- Total Units: 2
- Total Cost: RM 16,000 × 2 = RM 32,000

2.5 Wi-Fi Coverage

- Model: Cisco Catalyst 9100 Access Point
- Unit Price: RM 5,500
- Total Units: 6
- Total Cost: RM 5,500 × 6 = RM 33,000

3. Network Security Requirements and Equipment

3.1 Security Equipment and Costs

Equipment Type	Model/Specifications	Purpose	Unit Price (RM)	Quantity	Total Price (RM)
Next-Generation Firewall	Fortinet FortiGate 100F	Provides real-time threat protection	20,000	1	20,000
IDS/IPS	Cisco Firepower 1120	Detects and blocks network attacks	18,000	1	18,000

Network Access Control	Aruba ClearPass	Enforces access control policies	15,000	1	15,000
VPN Appliance	Cisco AnyConnect VPN	Enables secure remote access	12,000	1	12,000
SIEM System	Splunk Enterprise	Centralizes log management and analysis	25,000	1	25,000
Advanced Switch (VLAN)	Cisco Catalyst 9300	Supports VLANs and enhances security	15,000	4	60,000

Total Security Cost: RM 150,000

4. Cabling Costs

4.1 Horizontal Cabling

- Type: Cat6 Network Cable
- Length: 150 meters per area × 6 areas = 900 meters
- Unit Price: RM 3/m
- Total Cost: RM 3 × 900 = RM 2,700

4.2 Vertical Cabling

- Type: OM4 Fiber Cable
- Length: 50 meters (backbone)
- Unit Price: RM 15/m

- Total Cost: RM 15 × 50 = RM 750

5. Total Cost Summary

Item	Quantity	Unit Price (RM)	Total Cost (RM)
Lab and Classroom Workstations	180 units	3,000	540,000
Cisco Network Lab Equipment	4 switches + 1 router	-	73,000
Embedded Lab Equipment	30 sets	1,500	45,000
Classroom Equipment	2 sets	16,000	32,000
Wi-Fi Access Points	6 units	5,500	33,000
Network Security Equipment	-	-	150,000
Cat6 Horizontal Cabling	900 meters	3	2,700
OM4 Vertical Cabling	50 meters	15	750

Total Cost: RM 876,450

6. Feasibility Analysis

Budget and Remaining Amount

- Total Budget: RM 1,300,000
- Total Cost: RM 876,450
- Remaining Budget: RM 1,300,000 - RM 876,450 = RM 423,550

Conclusion

This design provides high-performance devices, reliable network infrastructure, and comprehensive security measures for 4 labs and 2 classrooms. With RM 423,550 remaining, the design is flexible for future expansions or upgrades, ensuring the Faculty of Computing can meet its long-term needs effectively.

10.3. People Consulted During the Project

Name	**Position**	**Role in Project**
Dr. Kaiyisah Hanis Binti Mohd Azmi	Lecturer	Provided feedback and guidance for all tasks.
Liuwanpeng	student	Consulted for device specifications and placement.
Zhaowei	student	Assisted in verifying device costs and availability.

11. report marks following the rubric

ITEM	MARKS	REASONING
Title page follows requirement	1	Title page included all necessary details such as project title, group name, and members.
TOC clearly and correctly done	1	Table of contents is structured, comprehensive, and aligns with the report sections.
List of Figures - available, appropriate and correctly done	1	Figures are appropriately labeled, titled, and referenced correctly.
Introduction: done well, help	4	Introduction is original, concise, and

with understanding, did not copy and paste		provides a clear overview of the project.
Project background clearly and correctly done	4	Background information is well-written, with relevant data and context.
A compiled solution (all tasks) with reflections	5	All tasks are compiled comprehensively, with insightful reflections included.
Conclusion clearly and correctly done	2	The conclusion provides a summary of achievements, strengths, and suggestions for future projects.
References clearly and correctly done	2	References are complete, properly cited, and follow academic standards.
Correctly formatted	1	The report is formatted as per the project requirements, ensuring clarity and readability.
Team Members and responsibilities	3	Each member's role is detailed, highlighting individual contributions and teamwork.
Team meeting minutes (all meeting minutes MUST be informational and specific)	4	Minutes are well-documented, capturing critical discussions and decisions.
Appendices: complete with all the requirements as in Project document	2	Appendices are thorough, including financial budget, meeting minutes, figures, and additional supporting documents.

Total Score: 30/30